Geophysical Research Abstracts
Vol. 21, EGU2019-8727, 2019
EGU General Assembly 2019

Parent material and depth effects on the age of radiocarbon in chemical fractions for Central German soils

Sophie F. von Fromm (1,2), Valerié F. Schwab (1), Susan E. Trumbore (1), and Marion Tichomirowa (2)

(1) Department of Biogeochemical Processes, Max-Planck-Institute for Biogeochemistry, Jena, Germany (sfromm@bgc-jena.mpg.de), (2) Institute of Mineralogy, TU Bergakademie Freiberg, Freiberg, Germany

Soils are the second largest carbon pool after the oceans and therefore play a crucial role in the global climate system. Yet, terrestrial carbon turnover rates represent one of the largest uncertainties in global climate models. This is mainly caused by the complexity and heterogeneity of soil organic matter (SOM). Carbon with long turnover rates (decadal to millennia) is currently assumed to make up a large portion of SOM. Several hypotheses have been presented to explain the existence of old carbon in soils, such as chemical recalcitrance, physical isolation by interactions with minerals, recycling and the influence of environmental and ecosystem properties.

Here, we investigated links between the age and chemistry of SOM at the molecular level. We applied a sequential chemical degradation technique adapted from Otto and Simpson (2007). The nature of the SOM in the extracts and the residues is based on its chemical structure and recalcitrance (e.g., types of lignin, sugars or fatty acids), and its mineral association (e.g., iron). Those fractions were analyzed for their radiocarbon (extracts and residues) and molecular composition (extracts) allowing further insights into the relations between SOM molecular structure, mineral association and age.

The influence of soil parent material on the age and chemistry of SOM was investigated for two different depths (0–10 cm and 30–60 cm) from six different sites in central Germany. These sites had the same vegetation (beech forest) and overall climate and surface age, but distinct bedrock types (limestone and sandstone). At all sites, the age of the fraction increased with depth and its chemical recalcitrance (e.g., oldest fraction after the last extraction step). The δ13C values of extracts were getting heavier with increasing age. Radiocarbon signatures of the different fractions clearly indicate an influence of parent material, with consistently older SOM found at the limestone sites compared with sandstone.

References

Otto A, Simpson MJ (2007) Analysis of soil organic matter biomarkers by sequential chemical degradation and gas chromatography – mass spectrometry. Journal of Separation Science 30: 272-282; doi 10.1002/jssc.200600243